32.

Muscle Dystrophy in Tree Kangaroos Associated with Feeding of Cod Liver Oil and Its Response to Alpha-Tocopherol.

Leonard J. Goss.

It is the purpose of this paper to report muscle dystrophy observed in tree kangaroos that conforms to that first produced artificially by Goettsch & Pappenheimer in Guinea pigs and rabbits maintained on a diet deficient in vitamin E. Similar lesions have been observed in rats by Evans & Lipschutz, who thought it to be of nervous origin. Olcott however definitely associated it with disease of skeletal muscles. A similar condition has also been seen in lambs and is known as "stiff lamb" disease.

The deleterious effect of oxidation on Vitamin E has long been known. It has also been shown that Vitamin E is affected by oxidation, when in association with such oxidizing agents as rancid oil. Madsen, McCay & Maynard showed that cotton seed oil containing a concentrate of Vitamins A and D in place of cod liver oil afforded a high degree of protection against muscular dystrophy in Herbivora and that one of the causative factors of the disease was in the saponifiable fraction of cod liver oil. McCay, Paul & Maynard prevented muscle lesions in Guinea pigs by using hydrogenerated cod liver oil in place of natural cod liver oil. In dealing with encephalomalacia of chicks, Pappenheimer & Goettsch showed that hydrogenation greatly stabilizes fats that ordinarily readily become rancid. With these facts in mind we wish to report the occurrence of muscle dystrophy in tree kangaroos, its response to Alpha-Tocopherol treatment and its occurrence when oils were added to the diet.

In June, 1938, four tree kangaroos were received at the New York Zoological Park, indirectly from Australia. From June, 1938, until April 20, 1939, these animals were each maintained in the Park on an average daily ration of 2 small raw potatoes, 1 raw apple, ¼ head of lettuce, ½ slice whole wheat bread, 1 medium-sized raw carrot and a small quantity of hay. The hay varied from alfalfa to mixed timothy and clover. On June 20, 1939, a fish oil mixture containing 3,400 units of Vitamin A and 660 units of Vitamin D per gram was added to the ration at the rate of 1 teaspoonful per animal per day. This oil mixture had been stored in a refrigerator since February, 1939, in a 29-gallon metal drum which was opened periodically to withdraw oil through a petcock.

On June 10, 1939, kangaroo No. 1 showed symptoms of stiffness, at which time the fish oil mixture was omitted from the balance of the usual ration. For a period of six weeks thereafter she was taken outdoors each day, weather permitting, and allowed to nibble on fresh green grass. Improvement was gradual and after six weeks of such treatment the symptoms of muscular stiffness had disappeared.

July 20, 1939, animal No. 2 developed symptoms of stiffness which became progressively worse and resulted in death in 2 days.

On September 22, 1939, animal No. 3 became stiff and died in 7 days.

The fish oil was removed from the diet when symptoms first appeared. All muscles, including the tongue, were severely affected.

On October 27, 1939, animal No. 4 became stiff and died in 6 days. All the dead animals showed extensive gross and microscopic lesions of muscle dystrophy, characterized by edema, opaqueness, a yellowish white coloration and in the later stages a gritty appearance. All voluntary muscles, including the tongue, were affected. The microscopic changes consisted of necrosis of the fibres, loss of fibrillar structure and calcium impregnation associated with varying stages of inflammatory reaction and myocytic regeneration.

Animal No. 1, which became stiff on June 10, 1939, was never put back on the fish oil diet but rather maintained on her original diet as outlined above. On January 19, 1940, she again developed typical symptoms of muscle dystrophy, this time without having had any oil. On January 20 the symptoms had become more marked and 25 milligrams of Alpha-Tocopherol were given by mouth. Three days later the symptoms had disappeared completely. This animal died July 3, 1940, of actinomycosis without having had a relapse since the administration of Alpha-Tocopherol. The second attack of muscular degeneration in the first animal affected is difficult to explain in the absence of oil in the diet. We must, however, assume that the regular ration bordered on deficiency in Vitamin E. This would account both for the occurrence of muscle degeneration in the animals when the oil was added to the diet and for the second attack in the one animal.

The results obtained when a fish oil mixture was included in the diet indicate that the oil itself has some action in producing muscular degeneration or that it inhibits the action of Vitamin E in preventing the disease.

References.

Goettsch, Marianne & Pappenheimer, A. M.

1931. Nutritional Muscular Dystrophy in the Guinea Pig and Rabbit. *J. Expr. Med.*, 54, 145.

1934. Nutritional Nyopathy in Ducklings. *Ibid.*, 59, 35.

Lipschutz, Daniel.

1936. Degeneration of the nerve tracts in young rats lacking Vitamin E. *Rev. Neurol.*, 65:221.

Madsen, L. L., McCay, C. M. & Maynard, L. A.

1933. Synthetic diets for Herbivora with special reference to the toxicity of cod liver oil. *Proc. Soc. Exper. Biol. & Med.*, 30, 1434.

Madsen, L. L.

1936. The comparative effects of cod liver oil, cod liver oil concentrate, lard and cottonseed oil in a synthetic diet on the development of nutritional muscular dystrophy. *J. Nutrition*, 11:471.

McCay, C. M., Paul, Henry & Maynard, L. A.

1937. The removal by hydrogenation of the properties of cod liver oil which are harmful to Herbivora, read before the meeting of the Amer. Chemical Society in Rochester in September.

Olcott, H. S.

1938. Paralysis in the young of Vitamin E deficient female rats. Proceedings of the Amer. Soc. of Biol. Chemists, 119 LXXIV (June) 1937. *J. Nutrition*, 15, 221 (March 1938).

Pappenheimer, A. M. & Goettsch, Marianne.

1934. Protection afforded by certain vegetable oils against nutritional encephalomalacia in chicks. *Proc. Soc. Exper. Biol. & Med.*, 31:777.